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Claims

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What is claimed is:

1. A transient dilution air control arrangement for controlling a dilution air supply to a partial flow dilution tunnel of a gas sampling system, the partial flow dilution tunnel being connected to an exhaust gas stream of an internal combustion engine, the gas sampling system having a first mass flow controller operatively connected to an inlet of the partial flow dilution tunnel, a second mass flow controller connected to an outlet end of the partial flow dilution tunnel and a filter interposed between the second mass flow controller and the outlet end of the partial flow dilution tunnel, said transient dilution control arrangement comprising:

a constant mass flow stream connected to the input of the partial flow dilution tunnel; and

a variable mass flow stream connected in parallel to said constant mass flow stream.

2. The transient dilution air control arrangement of claim 1, wherein said constant mass flow stream includes a pressure regulating valve serially connected with a critical flow venturi.

3. The transient dilution air control arrangement of claim 1, wherein said variable mass flow stream is connected in parallel with said constant mass flow stream.

4. The transient dilution air control arrangement of claim 1, wherein said variable mass flow stream includes a first pressure regulating valve serially connected with a dome loaded regulating valve and a mass flow transducer.

5. The transient dilution air control arrangement of claim 4, including a pressure regulating valve serially connected to a voltage to pressure controller.

6. The transient dilution air control arrangement of claim 5,  
wherein said voltage to pressure controller is connected to and receives electrical  
inputs from a flow measuring device and said mass flow transducer, said flow  
measuring device being adapted to measure the flow of intake air to the engine.

7. The transient dilution air control arrangement of claim 6, wherein said voltage to pressure controller is connected to and sends pressure signals to said dome loaded pressure regulating valve.

8. The transient dilution air control arrangement of claim 7, wherein an output from said dome loaded pressure regulating valve and said critical flow venturi supply dilution air to said partial flow dilution tunnel.

9. The transient dilution air control arrangement of claim 1, including a flow measuring device adapted to measure the flow of intake air, said flow measuring device being positioned in a conduit of an air intake of the engine.

10. The transient dilution air control arrangement of claim 9, wherein said laminar flow element is connected to a pressure differential transducer.

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11. The transient dilution air control arrangement of claim 10,  
wherein said pressure differential transducer is connected to a selectable gain  
circuit.

12. The transient dilution air control arrangement of claim 11,  
wherein said selectable gain circuit is switchable to handle one of a single  
channel input and a multiple channel input.

13. The transient dilution air control arrangement of claim 12,  
wherein said selectable gain circuit is selectable between a plurality of course  
settings.

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14. A gas sampling system for measuring particulate matter in an  
~~exhaust gas stream of an internal combustion engine comprising:~~

a partial flow dilution tunnel connected to the exhaust gas stream  
of the engine;

a first mass flow controller operatively connected an inlet of said  
partial flow dilution tunnel;

a second mass flow controller connected to an outlet end of said  
partial flow dilution tunnel;

a filter interposed said second mass flow controller and the outlet  
end of said partial flow dilution tunnel; and

a transient dilution air control arrangement being interposed the  
first mass flow controller and the inlet of said partial flow dilution tunnel, said  
transient dilution air control arrangement controlling a dilution air supply to said  
partial flow dilution tunnel.

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15. The gas sampling system of claim 14, wherein said second mass flow controller is a master controller and the first mass controller is a slave controller.

16. The gas sampling system of claim 14, wherein said transient dilution air control arrangement is positioned in close proximity to said partial flow dilution tunnel.

17. The gas sampling system of claim 14, including a sampling probe being positioned in the exhaust gas stream and the partial flow dilution tunnel.

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18. The gas sampling system of claim 14, including a supply of ~~scrubbed and filtered air being connected to said first mass controller~~

19. The gas sampling system of claim 14, including a flow measuring device adapted to measure the flow of intake air, said flow measuring device being positioned in a conduit of an air intake of the engine.

20. The gas sampling system of claim 19, wherein said laminar flow element is connected to a pressure differential transducer.

21. The gas sampling system of claim 20, wherein said pressure differential transducer is connected to a selectable gain circuit.

22. The gas sampling system of claim 21, wherein said selectable gain circuit is switchable to handle one of a single channel input and a multiple channel input.

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23. The gas sampling system of claim 21, wherein said selectable gain circuit is selectable between a plurality of course settings.

24. The gas sampling system of claim 14, including a vacuum pump connected to said second mass flow controller.

25. The gas sampling system of claim 14, including a solenoid valve connected in parallel between said first mass flow controller and said partial flow dilution tunnel and said partial flow dilution tunnel and said second mass flow controller.

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26. The gas sampling system of claim 14, wherein said transient dilution air controller divides the dilution airflow into a constant mass flow stream and a variable mass flow stream.

27. The gas sampling system of claim 26, wherein said constant mass flow stream includes a pressure regulating valve serially connected with a critical flow venturi.

28. The gas sampling system of claim 26, wherein said variable mass flow stream is connected in parallel with said constant mass flow stream.

29. The gas sampling system of claim 26, wherein said variable mass flow stream includes a first pressure regulating valve serially connected with a dome loaded regulating valve and a mass flow transducer.

30. The gas sampling system of claim 29, including a pressure regulating valve serially connected to a voltage to pressure controller.

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31. The gas sampling system of claim 30, wherein said voltage to pressure controller is connected to and receives electrical inputs from a flow measuring device and said mass flow transducer, said flow measuring device being adapted to measure the flow of intake air to the engine.

32. The gas sampling system of claim 31, wherein said voltage to pressure controller is connected to and sends pressure signals to said dome loaded pressure regulating valve.

33. The gas sampling system of claim 32, wherein an output from said dome loaded pressure regulating valve and said critical flow venturi and supply dilution air to said partial flow dilution tunnel.

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34. ~~A gas sampling system for measuring particulate matter in an exhaust gas stream of an internal combustion engine comprising:~~

~~a partial flow dilution tunnel connected to the exhaust gas stream of the engine;~~

~~a first mass flow controller operatively connected an inlet of said partial flow dilution tunnel;~~

~~a second mass flow controller connected to an outlet end of said partial flow dilution tunnel;~~

~~a filter interposed said second mass flow controller and the outlet end of said partial flow dilution tunnel; and~~

~~means for controlling dilution air to said partial flow dilution tunnel, said means being interposed the first mass flow controller and the inlet of said partial flow dilution tunnel.~~

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35. The gas sampling system of claim 34, wherein said second mass flow controller is a master controller and the first mass controller is a slave controller.

36. The gas sampling system of claim 34, including a sampling probe being positioned in the exhaust gas stream and the partial flow dilution tunnel.

37. The gas sampling system of claim 36, wherein said sampling probe is a square root extractor.

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38. The gas sampling system of claim 34, including a supply of scrubbed and filtered air being connected to said first mass controller.

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39. The gas sampling system of claim 34, including a flow measuring device connected to said means for controlling dilution air, said flow measuring device being adapted to measure the flow of intake air, said flow measuring device being positioned in a conduit of an air intake of the engine.

40. The gas sampling system of claim 39, wherein said flow measuring device is a laminar flow element.

41. The gas sampling system of claim 39, wherein said laminar flow element is connected to a pressure differential transducer.

42. The gas sampling system of claim 41, wherein said pressure differential transducer is connected to a selectable gain circuit.

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43. The gas sampling system of claim 42, wherein said selectable gain circuit is switchable to handle one of a single channel input and a multiple channel input.

44. The gas sampling system of claim 34, wherein said selectable gain circuit is selectable between a plurality of coarse settings.

45. The gas sampling system of claim 34, wherein said means for controlling dilution air divides the dilution airflow into a constant mass flow stream and a variable mass flow stream.

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46. The gas sampling system of claim 45, wherein said constant mass flow stream includes a pressure regulating valve serially connected with a critical flow venturi.

47. The gas sampling system of claim 45, wherein said variable mass flow stream is connected in parallel with said constant mass flow stream.

48. The gas sampling system of claim 45, wherein said variable mass flow stream includes a first pressure regulating valve serially connected with a dome loaded regulating valve and a mass flow transducer.

49. The gas sampling system of claim 48, including a pressure regulating valve serially connected to a voltage to pressure controller.

50. The gas sampling system of claim 48, wherein said voltage to pressure controller is connected to and receives electrical inputs from a flow measuring device and said mass flow transducer, said flow measuring device being adapted to measure the flow of intake air to the engine.

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51. The gas sampling system of claim 50, wherein said voltage to pressure controller is connected to and sends pressure signals to said dome loaded pressure regulating valve.

52. The gas sampling system of claim 51, wherein an output from said dome loaded pressure regulating valve and said critical flow venturi supply dilution air to said partial flow dilution tunnel.

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